

**Consumer Acceptance and Readiness to Pay for Green Juices Containing Grain Grass Juices in Kosovo**



**Biotechnology and Food**

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**Abstract**

Green juices containing grain grasses such as wheatgrass, barley grass, oat grass and alpha alpha grass are considered nowadays novel functional foods, super food or specific food, because of their high content of health promoting nutrition's such as antioxidants, polyphenols, chlorophyll, amino acids, minerals, vitamins, active enzymes and other nutrients. Such green juices are an innovation, therefore it was of crucial importance to conduct sensory analyses to determine the consumer acceptance and readiness to pay, as well as juice extraction yield for cost calculations and decision making on commercial potentials of these promising future products. The study evaluated sensory characteristics and consumer acceptance of green juices extracted from wheatgrass, barley grass and oat grass, as well as the best rated grass extracts of this research-Wheatgrass juice in formulation with 6 different 100% fruit juices. The commercial juices involved in this research are: apple juice, wild apple (*Malus sylvestris*) juice, Strawberry 30% and Apple 70% Juice, Sour cherry 30% and apple70% juice, peach 30 % and apple 70% juice, apricot 30% and apple70% juice. A five 5 point structured hedonic evaluation test for acceptance was conducted with 62 non-professional panelists. Data collected by the evaluation forms was processed using Statistical Regression and Descriptive Analysis to obtain important statistical values such as the average acceptance-means, standard deviations, coefficients of variation, correlation analysis for each analyzed organoleptic characteristic, as well as the overall mean acceptance and standard error of each sample. The juices involved in this research were also assessed for pH, Total Soluble Content oBrix, Titrable acidity, and sugar/acid ratio because of their direct interference in sensory attributes of juices.

**Introduction**

Nowadays, there is increased consumer demand for high-antioxidant foods. Drinking high-antioxidant beverages may help to protect against aging, Alzheimer's disease, and other chronic diseases (Nanasombat et al 2014).

Cereal grasses (young shoots of grain-bearing plants) including alfalfa, barley grass; wheatgrass are one such type of Green foods which are very beneficial for a healthy body. (Singhal Ashish et al 2012).

Such nutrient-rich green juices are bursting with goodness, from their essential vitamins and minerals to phyto-nutrients that are rarely found in other foods in such high concentrations. In order to benefit from the healing and nutritive properties of wheatgrass, barley grass and oat grass, the body must be able to absorb vital nutrients. Humans cannot digest cellulose or fiber, so grass juices are the best way to get crucial nutrients into human bodies.

Considering their high values of health promoting phyto-chemicals and very rich nutritional values of green juices as well as considering that green juices containing grasses are an innovation in juice industry, it was of crucial importance to conduct a study with the goal of evaluating the sensory attributes for consumer acceptance of these products, the juice extraction yield for cost calculations and decision making on their commercial potential as well as consumers readiness to pay for this innovative food.

**Wheat Grass**

The Wheat Grass refers to the young grass of the common wheat plant, *Triticum aestivum* that is freshly juiced or dried into powder for animal and human consumption. Both provide chlorophyll, amino acids, minerals, vitamins, and enzymes. Wheat grass is a humble weed that is a powerhouse of nutrients and vitamins for the human body. In the form of fresh juice, it has high concentrations of chlorophyll, active enzymes, vitamins and other nutrients (Bodla 2011), "fifteen pounds of wheatgrass is equal in overall nutritional value to 350 pounds of ordinary garden vegetables" (Meyerowitz 1992).

Wheatgrass is proven to have high antioxidant activity. Antioxidant activity of the wheatgrass juice was compared with the standard drug ascorbic acid. From the graph of percent inhibition and IC50, it shows that

wheatgrass juice is having significant antioxidant activity that is comparable to the standard drug ascorbic acid (Ashok 2011).

Wheatgrass juice is an integral part of the macrobiotic diet under the complementary and alternative medicine (CAM) approach of anticancer therapy, due to its high antioxidant content (Dhamia et al 2010).

Comprehensive data from number of studies has revealed the multitude effects of wheatgrass in thalassemia, hemolytic anemia, cancer, asthma, allergy, inflammatory bowel disease and detoxification. The structural homology of chlorophyll with hemoglobin indicates the role of chlorophyll as a blood builder in various clinical conditions involving hemoglobin deficiency – thus the name “green blood”. To conclude, the wheatgrass seems to be a very promising herbal drug. (Padalia et al 2010).

The pH (hydrogen molecules) value of both human blood and wheatgrass is about 7 (alkaline) and is therefore quickly absorbed in the blood and is highly beneficial. (Bodla 2011)

### **Barley Grass**

The Barley grass can be defined as the young grass of the common barley plant *Hordeum vulgare*.

Health Benefits of Barley Grass - The Barley grass contains four times the amount of calcium as a glass of milk, and as much protein as one ounce of steak. It also has about twenty times more iron than spinach does and is rich in vitamins A, C, E, K, and B complex. It has every amino acid that human body requires and is great for those trying to lose weight or get a good night's sleep.

Since it has so many antioxidants, it helps in protection from numerous conditions, including cancer, heart disease, cognitive decline, and digestive issues. Finally, it helps protect against signs of aging and alkalizes the body so that your immune system functions well and diseases such as cancer are unable to thrive. (Chatham 2012).

Same as wheatgrass, barley grass is also being marketed commercially as a super food, but between the two, wheatgrass is reported to contain a much higher level of vitamin E, selenium, phosphorus, manganese, chlorophyll, etc. (<http://juicing-for-health.com/basic-nutrition/healing-vegetables/health-benefits-of-wheatgrass-juice.html>).

### **Oatgrass**

The Oat Grass for juicing is harvested at the peak of its life cycle, when the new growth of the grass is just about 14 days old. At this stage, the sun's energy has infused the delicate blades of grass with some of the most powerful weapons for full body healing.

The Oat Grass Juice is one of the richest sources of nutrients on the planet. It not only contains an abundance of amino acids, ones that are in ideal proportion for human consumption, it is also packed with critical vitamins, including B1, 2, 6, and 12. Oat Grass Juice is rich in minerals, vitamins, antioxidants, chlorophyll and also rich in enzymes. (<http://www.sunburstsfoods.com/organic-oat-grass-juice-powder/>).

#### **The aim of this research is to:**

- Identify the consumer acceptance of green juices containing grass extracts.
- Between the three analyzed features to find out which one is most acceptable.
- Evaluate sensory characteristics and consumer acceptance of best ranged grass juice in formulation with 6 different 100% fruit juices.
- To identify the juice extraction yield for wheatgrass, barley grass and oat grass
- To determine the consumer readiness to pay for such novel functional foods

## Material and Methods

Green juices extracted from Wheatgrass, Barley grass, Oat grass and commercial pasteurized 100% apple, wild apple (*malus sylvestris*), strawberry, sour cherry/apple juice, peach and apricots juices (produced by MOEA/Frutomania LLC in Kravarice, Gjilan Kosovo) were used in this research.

### Juice extraction

Experimental land plots were planted with wheatgrass, barley grass and oat grass to be harvested on their so called jointing stage that means after the second leaf has grown as the half of the first leaf. Then, the grasses were cleaned and immediately juiced and stored on refrigerator at 7°C until the next day when the sensory analyses took place.

The juicing has been conducted by Fruit, Vegetable and Wheatgrass juicer **Omega 8224 Nutrition Center Juicer**, which is a **masticating style juice extractor**. Its ability to juice at low speeds – 80 RPM minimizes heat build-up and oxidation. The result is healthy fresh juice with the high enzyme content that health conscious individuals crave. Nutrition centers are engineered with powerful components that can easily extract juice from wheatgrass and leafy vegetables.

**Juice extraction yield** extracted with **Omega 8224 Nutrition Center Juicer expressed by 1 juice/kg grass** was for wheatgrass 0.7 l/kg, for barley grass was 0.6 l/kg and for oat grass 0.8 l/kg.

### Formulations

Nine formulations were prepared using wheatgrass juice, barley grass juice, oat grass juice and apple juice. Three analyzed samples were fresh extracted raw green juices from wheatgrass, barley grass and oat grass and the other Six formulations were prepared using freshly extracted wheatgrass juice and commercial, pasteurized, 100% fruit juices, produced in MOEA L.L.C Kosovo. The commercial juices involved in this research are: apple juice, wild apple (*Malus sylvestris*) juice, Strawberry 30%/Apple 70% Juice, Sour cherry 30%/apple 70% juice, peach 30%/apple 70% juice and apricot 30%/apple 70% juice. The composition of the formulations involved in this research and their sample code are shown in Table 1 below.

Table 1- Wheatgrass, barley grass, oat grass and fruit juice formulations used in the research

Sample code/ material	Wheatgrass juice (%)	Barley grass juice (%)	Oat grass juice (%)	Apple juice (%)	Wild apple (%)	Strawberry30% apple juice 70% (%)	Sour cherry juice30% /Apple 70% (%)	Peach juice30%/ apple juice 70% (%)	Apricot juice 30%/apple 70% (%)
1	100	0	0	0	0	0	0	0	0
2	0	100	0	0	0	0	0	0	0
3	0	0	100	0	0	0	0	0	0
4	30	0	0	70	0	0	0	0	0
5	15	0	0	60	25	0	0	0	0
6	15	0	0	0	25	60	0	0	0
7	30	0	0	0	0	0	70	0	0
8	15	0	0	0	25	0	0	60	0
9	15	0	0	0	25	0	0	0	60

### **Physical, physico-chemical and chemical analysis**

The wheatgrass juice, barley grass juice, oat juice and their respective formulations with fruit juices were analyzed for the pH (by using an electronic pH meter), Total Soluble solids (TSS) as °Brix (by using a hand refractometer) and Titrable acidity, according to AOAC (1995). To determine the sugar/acid ratio it was divided the sugar concentration (°Brix) by the % acid concentration.

### **Sensory analysis**

A five 5 point structured hedonic evaluation test for acceptance was conducted with 62 non-trained panelists. The evaluation scale was 1= unacceptable - disliked extremely, 2 = bad - disliked moderately, 3 = average - neither liked nor disliked, 4 = Good - moderately liked, 5 = Excellent - extremely liked.

The panelists were asked to evaluate the following sensory attributes: Appearance/Color, aroma, intensity of aroma, taste, consistency and overall perception. The order of sample presentation was completely randomized for each panelist (Wakeling & MacFie, 1995).

The panelists were divided into three groups, first group of 19 panelists that evaluated samples from 1 to 3, second group of 22 panelists that evaluated samples with codes 4-6, and the second group of 21 panelists that evaluated samples 6-9.

In the evaluation form, the panelists were asked: “as consumers how much would you pay for 1l juice of your preferred degustated sample” to determine the consumers’ readiness to pay for such of green juices.

Additional information concerning sex and age were asked at the end of the test in order to characterize the population sample.

### **Statistical analysis**

The obtained primary data was then analyzed mainly by using Statistical Regression Analysis and Descriptive statistics.

Descriptive statistics of the evaluation of organoleptic traits of formulations involved in this research, such as mean acceptance, standard deviation and coefficient of variation were calculated by General Statistic Methods.

The test involved 62 panelists, 20 Male and 42 Female, aged 18-32.

The reason for this young population involvement relies on the fact that all the panelist are students of the department of Food Technology and are selected since they have undergone some basic trainings on sensory evaluation during their coursework, although they are not professional degustators.

## Results and Discussions

The results obtained from physical, physico-chemical and chemical analyses are collected in the Table2.

Table 2. pH, Total Soluble Solids (TSS), total titrable acidity (TTA), sugar/acid ratio values of the samples involved in this research:

Sample code/ analysis	Sample formulation	pH	TSS °Brix	TTA g/l malic acid	Acidity %	Sugar/acid ratio (°Brix /%acid)
1	Wheatgrass juice 100%	6.43	3.5	2.34	0.23	15.21
2	Barley grass juice 100%	6.04	3	1.40	0.14	21.4
3	Oat grass juice 100%	5.94	3.5	2.07	0.21	16.6
4	Wheatgrass/Apple juice	3.77	9	2.01	0.20	45
5	Wheatgrass/Apple/wild apple juice	3.56	8	2.67	0.27	29.6
6	Wheatgrass /Strawberry- apple juice	3.73	9.5	4.02	0.40	23.7
7	Wheatgrass/Sour cherry- apple juice	3.77	12	3.08	0.31	38.7
8	Wheatgrass/Peach-apple juice /wild apple juice	3.69	11.2	3.81	0.38	36.1
9	Wheatgrass/ Apricot- apple juice / wild apple juice	3.45	11.5	6.03	0.60	19.16

The pH of fresh extracted grasses was 6.93 for wheatgrass, 6.89 for Barley grass and 6.86 for Oat grass.

The reason for this lowering of pH values could be because the grass juices was extracted one day before the sensory test was carried out and kept in refrigerator at 7°C.

The pH values of samples vary from the lowest pH 3.45 for sample 9 to 6.43 for sample Nr 1.

The TSS Values in Brix for grasses was 3-3.5 and for wheatgrass respective formulations with fruit juices we have 8°Brix for sample 5, while the higher value is 12°Brix for sample 7.

TTA expressed in g/l Malic acid was the lowest for value 1.4 for sample No. 2 and the higher 6.03 for sample No.9. While the Sugar/Acid Ratio varies from 15.21 to 45 and it is the lowest for sample No. 1 and the highest for sample 4.

Consumer readiness to pay for grass juices analyses

In the evaluation form, the panelists were asked: “as consumers how much would you pay for 1l juice of your preferred degustated sample” to determine the consumers readiness to pay for such of green juices.

The results of this questionnaire review are the following Table:

Table 3. Statistical analysis of consumer readiness to pay for green juices containing grass extracts.

Total degustators	Mean price	SD	CV
62	2.05	0.67	0.33

### Sensory Analyses

The average ratings, standard deviations, and coefficients of variation were initially calculated for all the panelists for each analyzed feature, including Appearance/Color, Aroma, Intensity of Aroma, Taste, Consistency, and Overall Perception. These values along with the mean acceptance, mean SD, and mean CV parameters are shown in following table.

Table.3 Average rating of analyzed features for all samples and Values of Mean Acceptance, mean Standard Deviation-SD and Coefficient of Variation for all samples involved is this test.

Sample code/Feature	Appearance / Color	Aroma	Aroma intensity	Taste	Consistency	General Impression	Mean Acceptance	Mean SD	Mean CV
Sample 1	4.30	2.00	4.20	2.20	3.80	3.00	3.25	0.704	0.217
Sample 2	3.70	2.30	3.50	1.60	3.40	2.60	2.85	0.425	0.149
Sample 3	3.20	2.30	3.10	1.80	3.10	2.60	2.68	0.524	0.195
Sample 4	3.45	2.64	3.50	3.41	2.91	3.55	3.24	0.343	0.106
Sample 5	3.27	2.64	3.31	2.77	2.77	3.14	2.98	0.265	0.089
Sample 6	3.24	3.33	4.42	3.01	3.31	3.43	3.45	0.451	0.130
Sample 7	4.36	3.10	3.65	3.43	3.62	3.90	3.68	0.390	0.106
Sample 8	2.90	2.62	3.45	2.52	2.95	2.86	2.88	0.297	0.103
Sample 9	2.98	2.19	2.54	2.33	3.19	2.67	2.65	0.348	0.131

Mean acceptance for sensory attributes of 9 samples varies from 2.65 to 3.68. The best ranged or best accepted by consumers of grass juices was wheatgrass juice- sample 1 - with the mean value of acceptance 3.25, SD 0.704 and CV 0.217. This was the reason why the research continues with the wheatgrass and fruit juices.

The best ranged or best accepted by consumers from all formulations was sample 7 - Wheatgrass/Sour cherry/Apple juice- with the mean value of acceptance 3.68, SD 0.390 and CV 0.106.

The less accepted or ranged with mean value of acceptance 2.65, SD 0.348, and CV 0.131 was sample with code 9 -Wheatgrass/ Apricot/ Wild apple juice.

If we look carefully to the Table 2 on physic, physic-chemical and chemical analysis, it is evident that unlike other samples, most liked sample has the higher TSS value of 12 °Brix, as well as second highest sugar/acid ratio of 38.7 oBrix/% acid. Whilst, the least liked or accepted formulation, sample with code 9, has the lowest pH value of 3.45, the higher acidity 6.03 g/l malic acid, and the lower value of sugar/acid ratio of 19.16 oBrix/% acid.

Thus, it is concluded that less acidic formulations and higher content of sugar is preferred. This conclusion matches also many of the suggestions of the panelists who declared that they would prefer sweeter taste. Among comments and suggestions it was found also the need for improving taste by sweetening, enhancement of aroma, melioration of consistency by elimination precipitation problem.

The mean Standard Deviation varies from minimal 0.265 for sample Nr. 5 to max. 0.704 for sample nr. 1, while for the mean Coefficient of Variation we have a min of 0.089 and max 0.217.

The organoleptic evaluation for Appearance/Color, Aroma, Aroma intensity, Taste, Consistency, and General Impression for each sample is given by following graphic.

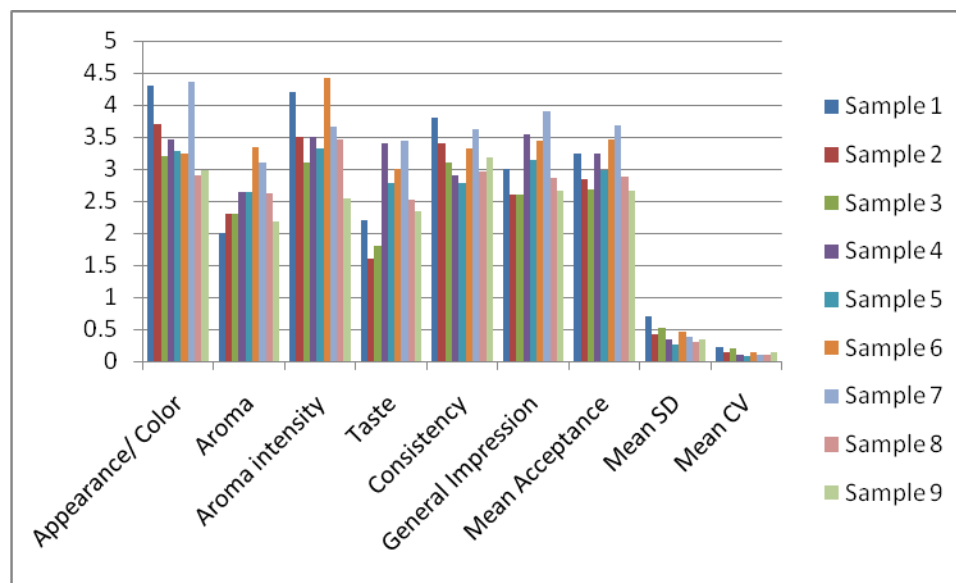


Figure 1. Data analysis on rating of all features for all samples involved in this research

### Correlation Analysis

The higher correlation value for General Impression of 0.97 was found for the Taste, and the lowest for consistency 0.50.

Whilst for the Mean Acceptance the higher correlation value was same for two traits 0.88 Taste and Aroma, and minimal correlation we've got 0.62 for Consistency.

### Conclusions

- Mean acceptance for sensory attributes of 9 samples varies from 2.65 to 3.68. The best ranged or best accepted by consumers of grass juices was wheatgrass juice- sample 1 - with the mean value of acceptance 3.25, SD 0.704 and CV 0.217. This was the reason why the research continues with the wheatgrass and fruit juices.
- The best ranged or best accepted by consumers from all formulations was sample 7 - Wheatgrass/Sour cherry/Apple juice- with the mean value of acceptance 3.68, SD 0.390 and CV 0.106.
- The less accepted or ranged with mean value of acceptance 2.65, SD 0.348, and CV 0.131 was sample with code 9 -Wheatgrass/ Apricot/ Wild apple juice.
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9, has the lowest pH value of 3.45, the higher acidity 6.03 g/l malic acid, and the lower value of sugar/acid ratio of 19.16 °Brix/% acid.

- Thus, it is concluded than less acidic formulations and higher content of sugar is preferred. This conclusion matches also many of the suggestions of the panelists who declared that they would prefer sweeter taste. Among comments and suggestions it was found also the need for improving taste by sweetening, enhancement of aroma, melioration of consistency by elimination precipitation problem.
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- Thus, it is concluded that less acidic formulations and higher content of sugar is preferred. This conclusion matches also many of the suggestions of the panelists who declared that they would prefer sweeter taste. Among comments and suggestions it was found also the need for improving taste by sweetening, enhancement of aroma, melioration of consistency by elimination precipitation problem.
- In the question “as consumers how much would you pay for 1l juice of your preferred degustated sample” involved in evaluation form, 62 panelists gave answer to this question and Mean given price for all panelists is 2.05 euro with SD of 0.67 and CV of 0.33
- The mean Standard Deviation varies from minimal 0.265 for sample nr. 5 to max. 0.451 for sample 6, while for the mean Coefficient of Variation we have a min of 0.089 and max 0.131.
- The higher correlation value for General Impression of 0.97 was found for the Taste, and the lowest for consistency 0.50.
- Whilst for the Mean Acceptance the higher correlation value was same for two traits 0.88 Taste and Aroma, and minimal correlation we’ve got 0.62 for Consistency.
- The tests revealed an average to good sensory acceptance and a very good extraction yield, thus suggesting a good commercial potential for the products.
- Finally, we can conclude that this study will provide a useful insight into production and marketing strategies for a new functional food line- green juices containing wheatgrass.
- The juices were extracted using an Omega 8224 Nutrition Center Juicer, and the juice extraction yield expressed by l juice/kg grass was 0.7 l/kg for wheatgrass, 0.6 l/kg for barley-grass, and 0.8 l/kg for the oat-grass.
- The tests revealed an average to good sensory acceptance and a very good extraction yield, thus suggesting a good commercial potential for the products.
- Finally, we can conclude that this study will provide a useful insight into production and marketing strategies for a new products line- green juices containing grass juices.

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